

Statement of

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before the

Subcommittee on Science, Technology and Space
Committee on Commerce, Science and Transportation
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Mr. Chairman, Members of the Committee, I am pleased to appear before you today to discuss Federal R&D funding. It seems entirely appropriate that we should be having this hearing today -- tax day -- for investments in research and development are among the highest-payback investments we make on behalf of America's tax payers.

I am encouraged by current efforts I have seen in Congress to build support for science and technology (S&T) investments. As you know, support for such investments has traditionally been a matter of bipartisan agreement. It is imperative that we share that common ground if we hope to keep America the world's leader in S&T.

Rapid advances in S&T have brought changes to our society that are only beginning to unfold. Information technologies provide the most dramatic examples of change -- transforming the way we work, where we work, and what we need to know to be successful in tomorrow's competitive environment. Six years ago, "Internet" was still a word known mostly to those in S&T. Today, this offspring of federal research activities is the backbone of a new industry and a window to a tremendous world of information for all segments of our society, from business executives to school children. More than 7.4 million Americans work in IT today -- and those jobs pay, on average, 60 percent higher wages than the average job.

As we approach the turn of the century, it seems appropriate to take stock of the Nation's S&T enterprise, and to look to the future -- to the opportunities that lie ahead as well as the challenges that we face.

DRIVING ECONOMIC GROWTH AND IMPROVING QUALITY OF LIFE

Investments in science and technology -- both public and private -- have driven economic growth and improvements in the quality of life in America for the last 200 years. They have generated new knowledge and new industries, created new jobs, ensured economic and national security, reduced pollution and increased energy efficiency, provided better and safer transportation, improved medical care, and increased living standards for the American people. Sustaining U.S. leadership in science and technology has been a cornerstone of President Clinton's economic and national security strategy.

Over the past 50 years technological innovation has been responsible for as much as half

of the nation's growth in productivity. Alan Greenspan recently stated that rapid technological change has greatly contributed to eight years of record peacetime expansion, and is one of the forces producing what he called "America's sparkling economic performance."

We see the fruits of technological innovation every day. Many of the products and services we have come to depend on for our way of life in America – from lasers, to teflon, to communications satellites, or human insulin – are the product of U.S. policies to encourage investments in S&T.

Our federal investments have helped build key industries, including:

Biotechnology: Federal investments spawned discoveries in biology, food science, agriculture, genetics, and drugs that the private sector adopted to build and expand a world-class industry representing \$13.4 billion in annual sales and more than 150,000 American jobs.

Aerospace: The aerospace industry grew out of federal programs and now leads all other industry sectors in net exports. The latest figures show the U.S. aircraft industry shipped nearly \$40 billion worth of commercial aircraft and employed more than half a million people.

Energy and Environmental Technologies: Federal R&D helped grow the environmental technology industry which now has annual sales over \$186 billion and employs 1.3 million Americans. Federal investments in this area also save consumers money. For example, technology advances, developed in part through public-private partnerships, have cut refrigerator energy consumption from 1900 kWh/year in 1974 to an average today of less than 650 kWh/year, reducing consumer electricity costs by \$100/year per refrigerator.

Many existing and emerging industries have been built on federal investments in R&D. From satellites, to software, to superconductivity the government has supported -- and must continue to support -- exploratory research, experimentation and innovation that would be difficult, if not impossible, for individual companies or even whole industries to afford.

PRESIDENT CLINTON'S FY 2000 R&D BUDGET

The President and the Vice President recognize that science and technology are crucial investments in our future. They know that S&T investments enable our nation to compete aggressively in the global marketplace, protect our environment, safeguard our national security, and contribute to our economic prosperity and quality of life. They have increased the investment in science and technology. They have brought the budget into balance. All of us, but especially our children and our grandchildren, will reap the rewards.

Despite the tight constraints on discretionary spending, FY 2000 is the seventh year in a row that the President has proposed increased investments in civilian research and development -- to a total of \$39.8 billion. Civilian R&D now constitutes 51% of the overall R&D budget of \$78.2 billion.

The FY 2000 boosts funding for basic research to \$18.2 billion, an increase of 4.2% (\$727 million) over FY 1999. The budget also strengthens university-based research, which increases by \$353 million, and reflects an effort to reestablish an optimum balance among scientific disciplines.

The 21st Century Research Fund continues to be the centerpiece of the President's R&D investment strategy. This year the Research Fund includes DOD basic and applied research programs, further evidence of the Administration's commitment to effective integration of the Nation's university-based research portfolio. The \$38 billion Research Fund grows by 3% in FY 2000 and provides for overall stability and for growth in the highest priority research programs.

The proposed R&D investments will enable the S&T agencies to achieve the President's goals for science and technology: promote long-term economic growth that creates high-wage jobs; sustain a healthy, educated citizenry; harness information technology; improve environmental quality; enhance national security and global stability; and maintain world leadership in science, engineering, and mathematics. For example:

- **National Institutes of Health (NIH).** Keeping pace with the Administration's ambitious goal last year for progress in biomedical research, the budget includes a 2% (\$320 million) increase. These investments will allow continued progress on diabetes, brain disorders, cancer, genetic medicine, disease prevention strategies, and development of an AIDS vaccine.
- **National Science Foundation (NSF).** The budget provides \$3.92 billion (a 7% increase) for NSF's broad base of support to all fields of scientific study. The budget provides \$146 million for NSF to lead the Administration's Information Technology in the 21st Century (IT5) initiative and also increases funding for biocomplexity research on biological, physical, chemical, and social interactions in Earth's ecosystems.
- **Department of Energy (DOE).** The budget provides \$2.84 billion (a 6% increase) for basic science programs at DOE. The budget includes resources for basic research as well as continued support for construction and operation of large scientific user facilities, including the Spallation Neutron Source. DOE's participation in IT5 (\$70M in FY 2000) will help to accelerate scientific discovery and research.
- **Department of Defense (DOD).** The budget provides \$1.1 billion in basic research, \$3 billion in applied research, and \$3.3 billion in advanced technology development. Research on counter-terrorism and on improvements in the safety and security of the Nation's physical infrastructure and information and communications systems receives a targeted increase.
- **National Aeronautics and Space Administration (NASA).** The budget provides \$2.48 billion for the International Space Station (an 8% increase). NASA's budget also includes \$2.2 billion for Space Science (a 4% increase over FY 1999); and \$1.46 billion for Earth Science (a 3% increase).
- **Department of Agriculture (USDA).** The budget provides a 3.5% increase, \$837 million, for the Agricultural Research Service. The Cooperative State Research, Education and Extension Service National Research Initiative -- which provides competitive grants in areas

of national concern such as food safety, the environment, plant and animal research, and human nutrition -- receives a 68% increase to a total of \$200 million. Funding for the Forest Service increases 19% to \$235 million in support of ecosystem and global change research.

- **Department of Commerce (DOC).** The budget includes \$918 million in the 21st Century Research Fund at DOC. It provides \$239 million (an 18% increase) for NIST's Advanced Technology Program to promote unique, rigorously competitive, cost-shared R&D partnerships. It also provides \$283 million to NOAA for research to support decisionmaking on climate change, air quality, and ozone depletion.
- **Department of the Interior (DOI).** The budget provides \$838 million (a 5% increase) to USGS for science that supports national resource and environmental decisionmaking. The budget also supports research and technical assistance on the scientific needs of land managers and local land use planners.

Interagency Initiatives

The budget increases investment in national priorities requiring multi-agency investments. For example:

- **Climate Change Technology Initiative.** The budget provides a 34% increase for this initiative, which includes \$1.4 billion in R&D on energy efficiency, renewable energy, carbon sequestration, and improvements in nuclear and fossil technologies. The initiative also provides \$400 million in tax credits to stimulate adoption of energy efficiency technologies.
- **U.S. Global Change Research Program.** The budget provides \$1.8 billion (a 6% increase) to observe, understand, predict, and assess the state of the Earth and how it changes in response to natural and human-induced forces.
- **Partnership for a New Generation of Vehicles (PNGV).** The budget provides \$264 million (a 10% increase) for this cost-shared, industry partnership. PNGV aims to develop affordable cars that achieve up to three times the fuel economy of comparable vehicles and meet all applicable emission and safety standards.
- **Education Research Initiative.** The budget provides \$50 million (\$25 million at NSF and \$25 million at ED) to support large-scale, interdisciplinary research in three key areas: school readiness for learning reading and mathematics; K-3 learning in reading and mathematics; and education of PreK-12 teachers in mathematics, reading, and science.

Initiative on Information Technology for the 21st Century

The most important new interagency effort in this year's budget is IT² -- the Initiative on Information Technology for the 21st Century. The President emphasized information technology (IT) research in his FY2000 R&D budget for three central reasons.

First, information technologies have become key drivers of the economy. During the past five years, these technologies have contributed to one-third of America's economic growth. The

use of computing, information, and communication systems has become pervasive in our economy, driving growth through applications in virtually every sector, from agriculture to manufacturing to financial services.

Second, information technologies are essential for achieving some of our most overarching public goals. From health care to education to protecting our environment, IT brings opportunities for advancing knowledge and developing new tools that improve productivity and quality, and that increase access to important services and information. The effectiveness of law enforcement operations is enhanced by secure communications, surveillance and tracking technologies, and authentication techniques derived from advances in IT. Advances in IT enable our military to maintain a technological edge. In addition, IT and its applications allow us to vastly accelerate the pace of research and discovery across *all* scientific fields -- giving scientists powerful new tools to examine challenging science and engineering problems, such as the origin of diseases, precise prediction of the track of hurricanes or tornadoes, the creation of new materials, or the basic structure of matter.

Third, Federal investments in fundamental IT research are essential to provide the reservoir of ideas that will lead to IT innovations in the generations to come. Past investments have led to the creation of key technologies -- among them digital computers, visualization tools, and the Internet itself -- and have been leveraged to create an array of billion dollar industries in computing and communications. Perhaps even more importantly, Federal research in universities has been responsible for training many of our leading IT researchers and entrepreneurs. Virtually every major U.S. information technology company is headed by someone who was supported directly or indirectly through Federal research dollars when in college or graduate school.

IT² responds directly to the recommendations of the President's Information Technology Advisory Committee (PITAC), which stated:

We believe that the Federal Government must retain and expand its role in leading long-term fundamental research in information technology. Advanced Government services and national security depend on it. The benefits to our Nation and society will be huge. A loss of international leadership in information technology would be economically devastating. We cannot rely on industry to fund the needed research because they necessarily focus, in view of economic realities, on the short term. Industry cannot and will not invest in solving problems of importance to society as a whole unless such investments make sense from a business perspective.

IT² will provide a \$366 million (28%) increase to six agencies for research in three main areas in FY 2000 (see figure 1). Building on a strong history of Federally-funded, multi-agency research programs, the initiative will build on important research conducted in ongoing programs -- such as HPCC, including the Next Generation Internet (NGI), and the Department of Energy's (DOE) Accelerated Strategic Computing Initiative (ASCI) -- and fund expansions into entirely new areas. (The combined HPCC/NGI and ASCI programs constitute the base Federal IT funding of \$1.5 billion, as described in the President's FY2000 budget, that will be leveraged by the IT² initiative.) The new investments under IT² will provide a critical first step towards developing a stronger, more balanced portfolio of Federal investments for IT research, as recommended by the PITAC.

Figure 1

IT² Funding by Agency

Agency	Fundamental Information Technology Research	Advanced Computing for Science, Engineering, and the Nation	Social, Economic, and Workforce Implications of Information Technology	Total
DoD	\$100M	---	---	\$100M
DOE	\$ 6M	\$62M	\$ 2M	\$ 70M
NASA	\$18M	\$19M	\$ 1M	\$ 38M
NIH	\$ 2M	\$ 2M	\$ 2M	\$ 6M
NOAA	\$ 2M	\$ 4M	---	\$ 6M
NSF	\$100M	\$36M	\$10M	\$146M
Total	\$228M	\$123M	\$ 15M	\$366M

The program of IT research proposed in the President's budget will pay-off handsomely in the nation's future. In crafting this plan, we have listened closely to the advice from business, higher education, public interest groups, and the Congress. I look forward to working on a solid bipartisan basis with the Congress in the coming months to bring this initiative to fruition. Such a partnership to stimulate scientific discovery and new technologies will take America into the new century well equipped for the challenges and opportunities that lie ahead. I would be pleased to provide the Committee with additional information upon request.

Budget Summary

The Clinton-Gore Administration has a solid record on S&T funding, including efforts to stimulate private investment. The FY 2000 budget provides \$2.4 billion to extend the Research and Experimentation (R&E) tax credit until June 30, 2000. The R&E credit helps stimulate additional private sector investment in research and development which encourages technological advancement, leading to higher productivity, and helping to generate new American jobs.

To conclude my remarks on the FY 2000 R&D budget, I would like to emphasize that the President's budget presents a balanced R&D portfolio, which recognizes the interdependence of all fields of science and engineering.

The President's request reflects his appreciation that diverse fields of research are intricately connected, with each breakthrough stimulating a chain reaction of advances in seemingly unrelated fields. The Senate budget resolution, which provides only for increases at NIH, stands in stark contrast to the President's vision for S&T. Certainly, increases for NIH are important — but it is essential that we also see increases in the budgets of NSF and the S&T programs in all the agencies. We want to work cooperatively, in a bipartisan fashion with Congress to support R&D, but it is crucial that the support be comprehensive, to ensure continued vitality and leadership across the frontiers of science.

A New Science and Technology Compact

Bipartisan cooperation in S&T is particularly important as we enter the 21st Century. The past 50 years have been exceptional times for science and technology, and the social benefits of Federally supported R&D are so large in number and so much a part of our lives that we can easily take them for granted. Will the past 50 years be atypical, or will we successfully forge a new post-Cold-War partnership between science and society that secures future benefits for all parties?

The Vice President has called on the scientific community to look for new opportunities in the New Millennium. He has called for the development of a "New Compact" between our scientific community and our government — one based on rigorous support for fundamental science, and also a shared responsibility to shape our breakthroughs into a powerful force for progress. He spelled out three prerequisites for a New Compact.

First, as we continue to probe the most fundamental questions of nature, we must do more to ensure the best use of science and technology to sustain our prosperity, create jobs, and grow the economy for the 21st Century. To illustrate this need, he unveiled the IT² initiative and announced the Administration's plan to request a renewal of the R&E tax credit.

Second, the Vice President said we must "make sure that we not only generate the fruits of discovery, but also share them." That means working to ensure that more of our people have access to technology, that we give our students the best education available in the world, leading to rewarding careers in science and technology. As the industrial revolution gives way to the information revolution, we must make sure that all American citizens gain the technical literacy they will need to compete and succeed. In a moment I will discuss efforts in this area.

Finally, the Vice President urged the scientific community to do more to make sure our newest technology helps advance our oldest and most cherished values. One example of our ongoing effort in this area is the work of the National Bioethics Advisory Commission, which is providing crucial guidance on the complex issues raised by biomedical research. IT² also emphasizes technology and values, with its allocation of \$15 million to examine the social, ethical and economic effects of the information revolution.

Access to Technology

I want to talk with you now about steps we are taking to make sure Americans have access to technology and the skills it will take to use technology successfully. Specifically, I want to talk about the S&T workforce of the future.

First I would like to briefly review some demographic trends that make the future of the S&T workforce a matter of grave concern. Secondly, I would like to highlight some pending actions by the Administration that will help ensure we start the next century on strong footing.

The demographic trends that give rise to concern about the future of the S&T workforce include the following:

- The percentage of our population of working age (18-64) is declining rapidly, which means that worker productivity must increase dramatically to drive a strong

economy. We depend on technological innovation – strongly influenced by the S&T workforce – for those increases in productivity.

- We have depended too heavily on non-Hispanic white males to form our S&T workforce. Their numbers are now declining as a percentage of our population far more rapidly than we are attracting women and minorities to S&T careers.
- The U.S. now lags key international competitors in the percentage of our population with science and engineering degrees. And improving economies abroad make it harder for us to attract foreign S&T workers to our country.
- There is some evidence that more women and minorities are going into science and technology, but their numbers currently are just enough to offset the declining number of non-Hispanic white males entering these fields, but not enough to keep up longterm, and not nearly enough to increase the total supply of workers to meet demand.

With these concerns in mind, the President directed the National Science and Technology Council (NSTC) to develop recommendations on how to achieve greater diversity throughout our scientific and technical work force. Two of the promising avenues we are exploring involve partnerships with community colleges and redirecting support for graduate education to be most productive.

We want to ensure that lessons learned from model programs like the Maricopa Advanced Technology Education Center can be generalized to other areas. In this program, the “semiconductor industries” team with Arizona’s Maricopa County Community College District (90,000 students), which is the nation’s second largest community college system to increase the number of students, especially women and minorities, who prepare for and become employed as technicians in the semiconducting manufacturing/supporting industries. The programs also prepare the students for transitions to four year colleges and universities. These and a number of related programs involving industry/community college collaboration receive financial support from the NSF’s Advanced Technology Education and the DoEd’s Tech Prep programs. It is vital that these programs receive the full funding proposed in the President’s budget.

Some of the Federal Laboratories are playing a similar role, since almost every federal laboratory, and its industrial neighbors, has difficulty hiring skilled technicians. For example, Los Alamos National Laboratory teams with the Northern New Mexico Community College for this purpose. The agencies will encourage such teaming, but I hope Congress will support this effort by appropriating the educational funds included in the President’s budget requests for the relevant federal agencies and laboratories. These are not functions that DoEd and the NSF can carry alone.

Now, let me turn to the graduate education in the sciences and engineering. As the Council on Competitiveness recently noted, with the exception of the life sciences, graduate enrollment in the sciences and engineering is either flat or declining. Foreign nationals make up a considerable fraction of those students (roughly one-third in engineering and computer science) and the fraction of them intending to return home to work is increasing. It is time, therefore, to reconsider how academic research is supported in the United States.

In the first decades after its establishment, the National Science Foundation awarded most of its funds to individual graduate students with great promise through the NSF Graduate Fellowship Program. Over the past few decades, a change has occurred where most of those funds are now awarded to faculty principal investigators, who use a major portion of them to provide stipends for their graduate students. NSTC will reconsider the balance between individual student fellowship support and funding for faculty principal investigators, in order to ensure adequate participation by all of our populace, including women, minorities and people with disabilities, in SE&T graduate programs.

As we consider ways to improve support for American graduate students, it is also crucial that we maintain strong policies favoring international scientific exchange throughout academia, government, and industry. Immigrant scientists have been, and will continue to be, of fundamental importance to the growth and development of science in the United States.

It is clear that the nation must continue to address the factors that limit the participation of a diversity of people in SE&T. The welfare of future generations is strongly dependent on that participation.

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Mr. Chairman and Members of the Committee, I hope that this overview has conveyed to you the extent of this Administration's commitment to advancing S&T in the national interest. We are delighted that the fiscal discipline exercised over the past seven years has produced a budget surplus that could ensure even greater investments in R&D that we can count on to yield economic and social benefits.

Regardless of party affiliation, in the end we can all agree that investments in S&T are investments in our Nation's future. I look forward to achieving bipartisan support for a national S&T strategy that will combine the resources of industry, academia, non-profit organizations, and all levels of government to advance knowledge, promote education, strengthen institutions, and develop human potential. I plan to use the resources of my office to help effect consensus on a New Compact over the next several months. PCAST and NSTC will produce documents that will illustrate the importance of our investments in S&T, and would be pleased to have input from your Subcommittee, Mr. Chairman.

I ask not only for your support for the President's Fiscal Year 2000 R&D budget request, but also want you to know how much I appreciate the long-standing bipartisan support of the committee for the S&T research enterprise. I would be happy to answer any questions that you have.